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ABSTRACT

The relationship of lateral awareness and directionality with intellectual ability, academic achievement, and age was investigated with 288 first through third grade elementary school children. With the exception of first graders, Ss were administered three tests: the Lockavitch Test for Lateral Awareness and Directionality (LTLAD), the Short Form Test of Academic Aptitude, and the California Achievement Test. First graders were only given the LTLAD. Among results were that right-left labeling ability correlated closely with intellectual ability and academic achievement; children who had difficulty with right-left discrimination did not exhibit problems confined to one specific academic area; and complete mastery of the right-left discrimination items was not achieved by any grades in the study. Tables provide statistical data. (SBH)

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The Relationship of Lateral Awareness and Directionality to Academic and Intellectual Ability

submitted by

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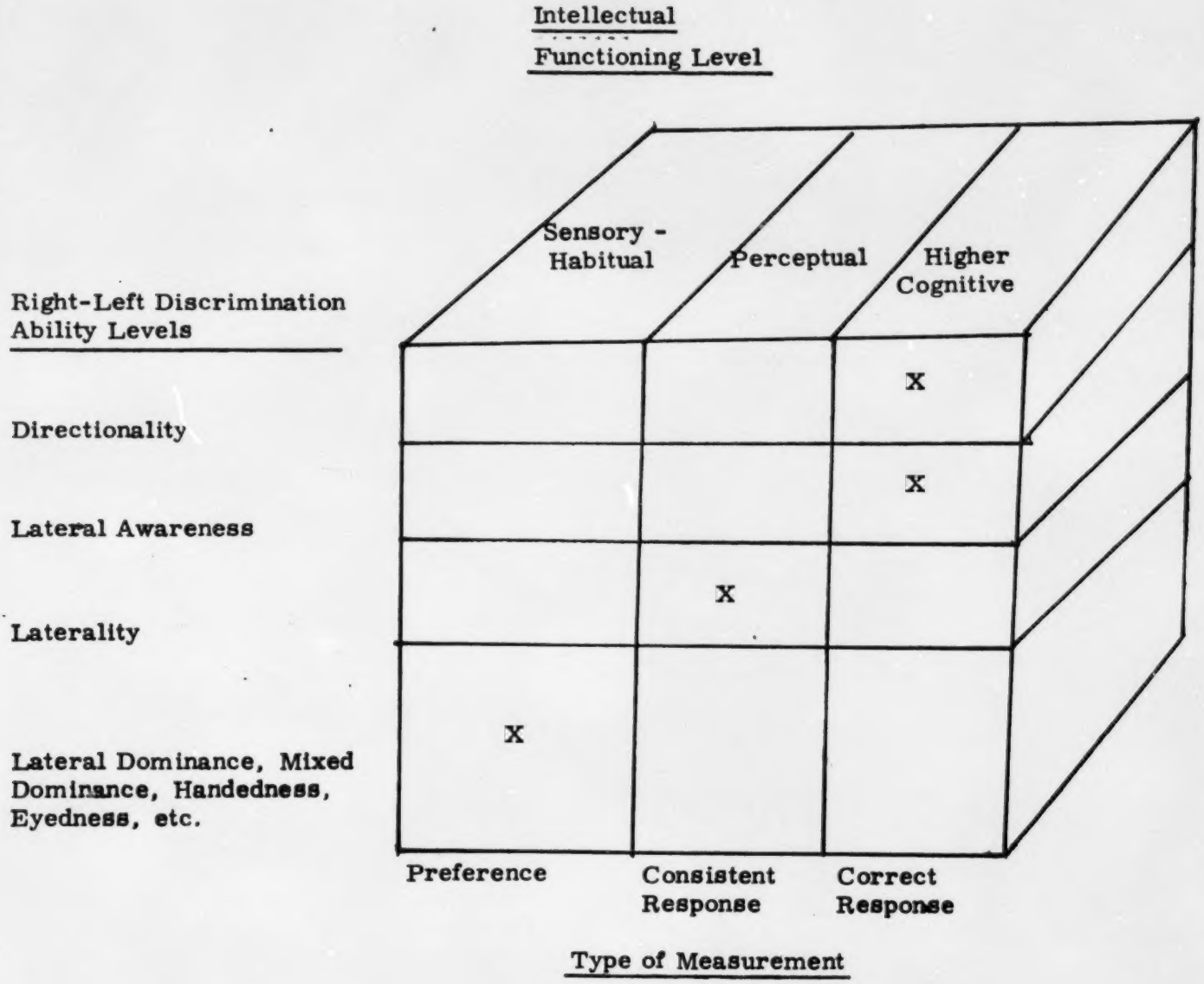
Right - left discrimination is a complex ability that contains within it many different levels of operation. Too often, definitions for these levels, rather than being discrete, have been used as if they were interchangeable. A distinction must be made between the terms: handedness, lateral dominance, mixed dominance, laterality, lateral awareness and directionality.

Figure 1 shows such a distinction. The first three terms (handedness, lateral dominance, mixed dominance) are much less complex. They occur at the sensory or habitual level and require little if any cognitive ability (Belmont and Birch 1963, Luria 1973). They merely acknowledge the existence (or lack of) a preference in the use of one identical body part or side over the other.

A student who consistently choses the use of one hand over the other is exhibiting handedness. A student who consistently uses the body parts of one entire side over those identical parts on the other side (right eye, right hand, right foot, right ear, etc.) is exhibiting a lateral dominance. A student who either shows no consistent choice (in one situation they will use their right hand or foot and in another situation they will use their left hand or foot) or whose choice over the use or identical body parts is not consistent to one entire body side (the student is right eyed, left footed, right eared, left handed, etc.) is exhibiting a mixed dominance.

FIGURE I A Taxonomic Expression of the Distinction Between The Different Levels of Right-Left Discrimination.



X denotes location of right-left discrimination ability levels

Tests used to identify handedness, lateral dominance, and mixed dominance are designed to measure the subject's 'use of' specific body parts and/or sides. Such tests are based on the examiner's observations of the subject's performance in given situations. Items on such instruments include: having the subject sight with a toy gun to determine what eye the subject uses, asking a subject to step up on a chair while noting which leg initiated the climb up and which leg initiated the step down, asking the subject to reach for an object and noting which hand the subject reached with, etc. Upon completion of these and other similar items the subject's responses are recorded (those who consistently used right sided body parts would be considered to have a lateral dominance, those who consistently used one hand over the other exhibited handedness, and so on).

Once the terms: handedness, eyedness, earedness, lateral dominance, mixed dominance, etc., are deleted, the remaining levels of right-left discrimination could be divided into the two areas of:

1. laterality, as measured by consistency in labeling
2. lateral awareness and directionality as measured by correctness of response

Laterality is an appreciation of the distinction between the two sides of the body and is believed to be established when the child responds consistently with one verbal label (either right or left) for body parts on one side of the body and the other verbal label for body parts on the other side of the

body. Whether the label of right or left is applied correctly is of no significance. The importance is placed on the consistency of response which is assumed to indicate a knowledge of body-side discrimination. (Benton 1959)

Examples of this type of testing for laterality can be seen in the work of Rice (1968) and Benton (1959). Both worked only with those who had "systematic" reversals. Children who failed to get 'perfect' scores (either all right or all wrong) were excluded. Benton (1959) believed that children with systematic reversals (consistent use of right for left and left for right) were children who were merely having trouble with conventional verbal symbols but who possess adequate ability to discriminate between the two sides of his body. He considered this difficulty in verbal terminology to be "of no real psychoneurologic importance and defined what he called the "right-left gradient" as the "bilateral pattern of sensory excitation. It provides the basis for the intuitive feeling of a difference between the two sides of the body." (p. 39)

Lateral awareness and directionality are higher cognitive functions that require the ability to accurately use the terms left and right. Measurement is based, not upon consistency of response, but on the correct response.

The distinction between directionality and lateral awareness is based on the relational requirements placed on the subject. In all

instances, the subject being examined is the primary reference, but in one situation, the subject assumes a reference point in which he is directly involved (relating persons or objects to his own right-left orientation - lateral awareness) while in the other (which involves a 90 or 180 degree change in orientation) the subject has to first mentally assume the position of some other person and object before the relationship can be studied (directionality).

Directions designed for the drawings in figure 1 illustrate the distinction between lateral awareness and directionality. Directions such as "mark the drawing where the boy is at the right and the girl is at the left" is an example of lateral awareness. In this situation, the correct response is exclusively dependent upon the relationship of the drawings to the subject (the subject first projects his own right and left orientation onto the page and then matches the pair of figures accordingly).

Directions such as "mark the drawing that shows the man at the woman's right" is an example of directionality. Because the drawings involve a 180 degree change in orientation, the subject must first mentally assume the position of one of the figures and then relate them accordingly.

The distinction between lateral awareness and directionality is based upon the orientation of the drawings. Recent research (Lockavitch, 1977) has shown that lateral awareness and directionality are separate constructs and that a variance in one can not account for a variance in the other. In either case, the concern is primarily with the language of right and left rather than with the recognition of a right-left side distinction (laterality).

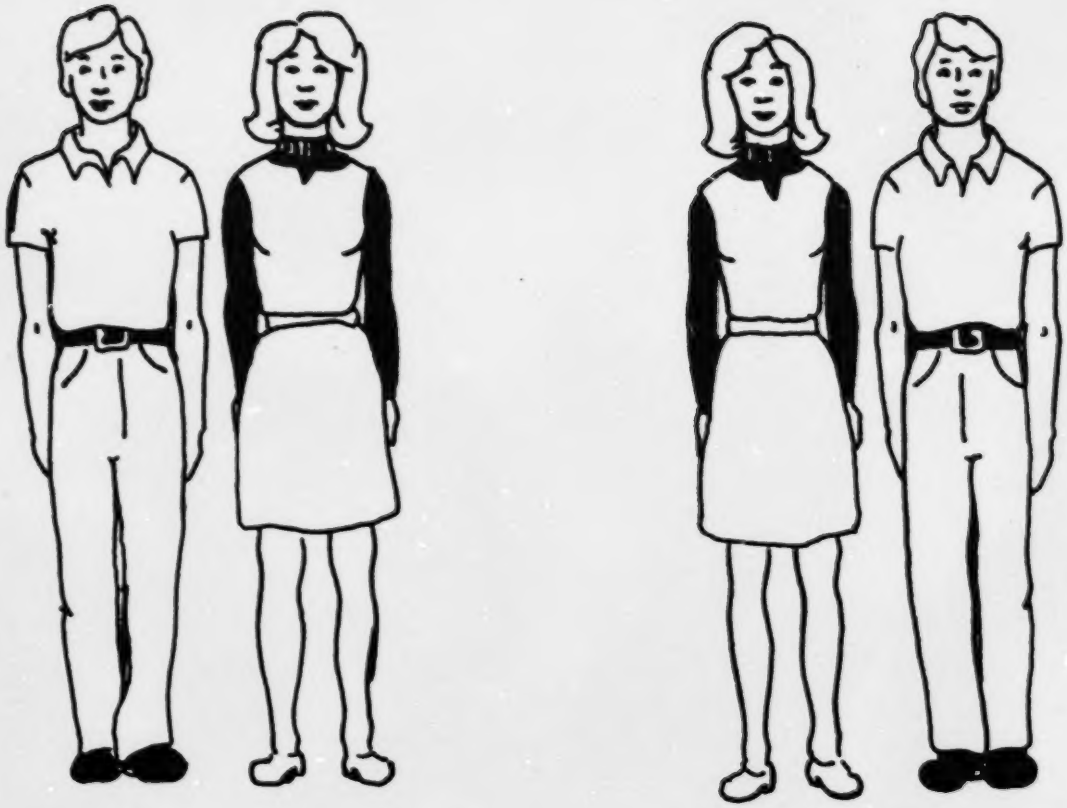


Figure 1 An Example of the Distinction Between the Direction for Lateral Awareness and Directionality.

"Mark the drawing where the boy is at the right and the girl is at the left" - Lateral Awareness

"Mark the drawing that shows the man at the woman's right" - Directionali

In summary right-left discrimination is a complex ability that contains within it many different levels of operation. Generally speaking the terms used in this area can be divided according to function. One set of terms (handedness, lateral dominance, mixed dominance) is concerned with the subject's 'use of' identical body parts or sides while the other set of terms (laterality, lateral awareness, directionality) is concerned with the subject's 'knowledge of' right-left discrimination and labels. The latter group can be further sub-divided into: the knowledge of a distinction between the body sides (laterality) and the knowledge in the use of the verbal labels right and left (lateral awareness, directionality).

The purpose of this research is to study the relationship of lateral awareness and directionality with intellectual ability, academic achievement, and age.

Procedure

Subjects: The subjects were 288 first through fifth grade elementary school schildren. The children all came from one school in a predominately white middle class community. All the children in the school who had parental consent were tested.

Tests: Three measuring instruments were utilized:
The Lockavitch Test for Lateral Awareness and Directionality (LTLAD), the Short Form Test of Academic Aptitude (SFTAA) and the California Achievement Test (CAT). The last two tests were not administered to the first grade children, thus eliminating the first grade from the intellectual and academic achievement aspects of this study.

The LTLAD was developed to meet the need for a measuring instrument that will adequately assess both lateral awareness and directionality. It is designed so that it can be given in either a group or individual assessment situation and represents in two dimensions what has traditionally been a three-dimensional inventory. It is composed of two subtests:

1. Lateral Awareness: the examinee relates the drawing directly to his own position.
2. Directionality: the examinee first assumes the position of one of the people or objects in the drawing.

LTLAD will yield three scores: one for each sub-test and a total score.

All items are read to the students and there is no limit to the number of times the student can have a question repeated.

The Lateral Awarness sub-test has 15 items in it while the Directionality sub-test has 20. There are no items shared by both sub-tests.

LTLAD has been shown to be a valid and reliable measuring instrument for elementary school children yielding reliability coefficients of .88, .95 and .93 respectively for the Lateral Awareness, Directionality sub-tests and the total LTLAD score (Lockavitch 1977).

SFTAA is a series of mental ability tests for use throughout the school years in Grades 1, 5 through 12. ... It was developed as an instrument to assess the level of intellectual development attained by the student, and to predict his potential rate of progress and level of success in school. The SFTAA, at each of the five levels, includes four sub-tests which measure respectively, vocabulary development, logical reasoning, education of quantitative relations, and meaningful memory." (Examiners Manual, Short Form Test of Academic Aptitude, 1970, p. 5).

The CAT, 1970 Edition "was designed for the measurement, evaluation, and analysis of school achievement. The emphasis is upon content and objectives in the basic curricular areas of reading, mathematics, and language. The intended measurement is one of performance in

these curricular areas." (Examiner's Manual, California Achievement Tests; 1970 Edition p. 5).

Results

It must be noted that there was an eight month discrepancy between the time when the SFTAA and the CAT were given (October 1976) and when the LTLAD was given (May 1977). Given this information and the knowledge that the total LTLAD and Directionality scores show significant relationships when correlated with age, one could anticipate even higher correlations if all three measuring instruments (LTLAD, SFTAA, CAT) were administered during the same time interval. Given this information, the study revealed that:

1. Right-left labeling ability correlates closely with intellectual ability and academic achievement.

When the LTLAD scores for the total population (second through fifth graders only; N = 226) were compared with the SFTAA and CAT, significant relationships ($p < .01$) were found in all areas with the sole exception of the SFTAA's language sub-test and the LTLAD's Directionality sub-test. In general, the intelligence and achievement scores correlated more highly with the total LTLAD scores, while the Directionality sub-test yielded consistently higher correlations than the Lateral Awareness sub-test. Table 2 shows a correlation matrix of the second through fifth graders LTLAD scores with the SFTAA and CAT.

The specific relationship of LTLAD with the SFTAA and the CAT becomes less clear when looked at according to grade level. Although the results indicate that contained within LTLAD and its two sub-tests are factors that significantly, and in many areas substantially correlate with intellectual and academic ability, their importance seems to vary both according to test (total LTLAD, Lateral Awareness and/or Directionality) and grade level. Table 3 shows a correlation matrix of the LTLAD scores with SFTAA and CAT according to grade level.

2. Children who have difficulty with right-left discrimination do not exhibit problems confined to one specific academic area.

It seems that problems can occur in any one or in any combination of the basic academic areas.

3. A small but significant relationship was found to exist between age in months, six months, and one year intervals and the Directionality and total LTLAD scores.

This was at the .01 level of significance. There was no relationship between age and Lateral Awareness. Table 4 shows the correlation matrix comparing LTLAD test scores with age.

A comparison of the mean LTLAD scores and standard deviations (see Table 5) indicates that there is steady improvement going on up through the grades (with the exception of third and fourth grade Directionality and total LTLAD scores).

TABLE 2

A Correlation Matrix of the Second-Fifth Grade's LTLAD Scores

With Their IQ and Academic Achievement Scores

On the SFTAA and CAT Respectively

(N = 226)

	IQ			READING			MATHEMATICS				SPELLING
TEST	Language	Non-Lang.	Total	Vocab.	Comp.	Total	Compu.	Conc.	Prob.	Total	
LA	.187**	.138	.197**	.239**	.215**	.234**	.216**	.242**		.236**	.215**
DIR	.112	.323**	.246**	.385**	.369**	.380**	.402**	.448**		.433**	.343**
LTLAD	.171*	.340**	.294**	.434**	.410**	.437**	.440**	.491**		.475**	.388**

* $p < .05$

** $p < .01$

Note: The abbreviations used in the correlations table are:

LA	- Lateral Awareness Sub-Test	Non-Lang-	Non-Language	Compu	- Computation
DIR	- Directionality Sub-Test	Vocab	- Vocabulary	Conc	- Concept and Problems
LANG	- Language	Comp	- Comprehension	Prob	-

TABLE 3

A CORRELATION MATRIX OF THE LTLAD SCORES WITH IQ AND ACADEMIC ACHIEVEMENT SCORES ON THE SFTAA AND CAT RESPECTIVELY

SECOND GRADE (N = 66)

	IQ			READING			MATHEMATICS			SPELLING
	Lang	Non-Lang	Total	Vocab	Compr	Total	Compu	Concpt Prob	Total	
TEST										
LA	.114	.112	.168	.160	.082	.136	.178	.333**	.280*	.045
DIR	.254*	.274*	.299*	.354**	.355**	.393**	.308*	.243*	.275*	.348**
LTLAD	.285*	.302*	.351**	.398**	.362**	.423**	.364**	.377**	.381**	.339**
					THIRD GRADE (N = 51)					
LA	.232	.144	.209	.231	.227	.219	.260	.241	.248	.255
DIR	.035	.262	.088	.144	.075	.109	.310*	.269	.314*	.169
LTLAD	.043	.297*	.152	.212	.145	.175	.380**	.335*	.380**	.245
					FOURTH GRADE (N = 57)					
LA	.420**	.178	.355**	.351**	.387**	.385**	.241	.227	.263*	.359**
DIR	.260*	.402**	.389**	.249	.357**	.329*	.374**	.521**	.474**	.068
LTLAD	.398**	.426**	.486**	.361**	.471**	.445**	.427**	.551**	.524**	.204
					FIFTH GRADE (N = 52)					
LA	.079	.093	.094	.220	.180	.195	.321*	.215	.292	.216
DIR	.200	.215	.228	.383**	.270	.332*	.395**	.351*	.401**	.256
LTLAD	.185	.203	.213	.383**	.281*	.335*	.437**	.358**	.428**	.286*

* p .05

** p .01

TABLE 4

A CORRELATION MATRIX COMPARING LTLAD SCORES WITH AGE IN MONTHS, SIX-MONTHS, AND ONE YEAR INTERVALS (N= 226)

	AGE IN:		
	MONTHS	SIX-MONTHS	ONE-YEAR
ATERAL AWARENESS	.081	.100	.109
RECTIONALITY	.263*	.251*	.232*
OTAL LTLAD	.265*	.262*	.248*

* $p < .01$

TABLE 5

A COMPARISON OF THE MEAN LTLAD TEST SCORES AND STAND DEVIATIONS ACCORDING TO GRADE LEVEL (N = 288)

		LA		DIR		LTLAD		PIAGET	ELKIND
E	N	M[a]	SD	M[b]	SD	M[c]	SD	M[d]	SD
	62	9.16	4.05	6.65	4.42	15.81	3.30	3.05	1.41
	66	11.44	2.71	9.61	5.36	21.05	5.86	4.06	1.37
	51	11.80	2.06	13.69	5.99	25.49	6.30	4.37	1.52
	57	12.00	2.70	11.75	5.93	23.75	6.71	4.82	1.34
	52	12.06	2.06	14.98	4.32	27.04	5.72	4.96	1.33

[a] Maximum Score = 15.

[b] Maximum Score = 20.

[c] Maximum Score = 35.

[d] Maximum Score = 6.

4. Complete mastery of the right - left discrimination items was not achieved by any of the grades in this study.

When Piaget's criterion for item mastery (in order to say an item has been mastered at an age or grade level, 75 percent of the students at that age or grade level must pass it) was employed, the best score achieved was the fifth grade's 21 out of 35 items mastered. Table 6 shows the number of LTLAD items passed by the first, second, third, fourth, and fifth grade students using Piaget's criterion of 75 percent passing. This evidence supports Mooney's (1976) research which states that for some students, mastery of right-left labeling ability occurs at a later date than normally would be expected.

TABLE 6

THE NUMBER OF LTLAD TEST ITEMS PASSED BY FIRST, SECOND, THIRD, FOURTH, AND FIFTH GRADE STUDENTS USING PIAGET'S CRITERION OF 75 PERCENT PASSING
(N=288)

Grade Level	No. of Directionality Items Passed	No. of Lateral Awareness Items Passed	Total No. of the 35 Items Passed
1	0	3	3
2	0	7	7
3	5	10	15
4	1	9	10
5	9	12	21

5. The distribution of students was bimodal.

Children generally fell into two groups: those who had good mastery of right - left discrimination and those who didn't. There was no middle ground. They either knew it or they didn't.

6. Inconsistency in performance was the most outstanding characteristic.

Among the children who exhibited difficulty, few had "pure" systematic reversals (the child gives all left answers for right and all right answers for left.) They simply were not consistent in their performance.

Discussion

Luria (1973) mentions that patients that have "lesions of the parieto-occipital region can no longer find their bearing within a system of spatial coordinates and, in particular, they can no longer distinguish correctly between right and left." (p. 149)

It is interesting to note that the characteristics that Luria (1971) uses to describe his patients with known lesions in the parietal regions of the brain mimic many of those characteristics used to describe children with specific learning disabilities, in particular:

1. the inability to distinguish left and right
2. difficulty in learning to read due to spatial confusions of lower case letters and words (was for saw, b for d, etc.)
3. difficulty in dealing with basic mathematical calculations

4. difficulty in learning to write

5. difficulty in telling time

6. difficulty in understanding abstract linguistic relationships

This data coupled with the knowledge that few if any of the children tested with LTLAD had a concrete mastery of the concepts of lateral awareness and directionality by age seven and in many cases eight, nine, ten and eleven years, lends support to the belief that the parietal region is one of the last regions to become operationally developed and that this does not generally occur until the age of seven years or later. (Luria, 1971) This information presented here plus new information being collected by this investigator indicates that right-left labeling ability (lateral awareness and directionality) rather than preference is the significant factor that correlates with academic achievement and intellectual ability.

It is important to recognize that the relationships found were not confined to any one particular academic area but seemed to involve various aspects of all of them. Such knowledge makes studies that attempt to find a causative factor between right-left discrimination and one particular area (reading or math) highly suspect.

Finally, it must be clearly understood that what is not being suggested is that children who exhibit the previously mentioned characteristics are brain injured. This simply is not true. A distinction must be made between adults who had these abilities and then lost them and children who have not yet acquired such skills.

What is being suggested is that in many instances the problems that the children are having might not be exclusively based on ability as much as it is readiness. Many children simply do not have the physiological prerequisites for certain academic skills and are failing or being frustrated simply because their "biological timeclock" is different than others. Such children simply are not ready to do what is being asked of them.

In summary, it can be said that children who exhibit difficulty with right-left labeling will experience frustration and/or failure in any one or any combination of areas. Specifically where and why are questions that were beyond the scope of this study.

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